Investigating Waves I - Energy and Amplitude

Andrea Harris
Orion Junior High School
aharris@weber.k12.ut.us

Course Name: 8th Grade Integrated Science

Standard Fulfilled: Standard IV: Students will understand the relationship among energy, force, and motion.

Objective Fulfilled: Objective 1: Investigate the transfer of energy through various materials.

a. Relate the energy of a wave to amplitude.

c. Describe the spread of energy away from an energy-producing source.

Intended Learning Outcomes Fulfilled:

1a. Observe objects and events for patterns and record both qualitative and quantitative information

1e. When given a problem, plan and conduct an experiment using a scientific method

4a. Provide relevant data to support inferences and conclusions

Time Needed to Complete Activity: 1-2 45-minute class periods

Prior Knowledge Needed: Students should be familiar with the scientific method and designing a "fair test."

Inquiry: What factors determine the height of a water wave? Structured Inquiry

Introduction: This activity should be used as the introductory experience for exploring waves and

wave characteristics. Students will watch a demonstration by the teacher then design

their own experiments to answer a teacher-constructed question.

Materials Needed for each Team of 2-3 Students:

- Large plastic washtub or other water-tight container (at least 40 cm square)
- Water to fill container about ½ full
- A couple of large pieces of gravel of obviously different masses or other similar object (to be dropped into water)
- 9 Strips of construction paper about 2 cm x 10 cm
- A meterstick

Hook:

After listening to Surfin' Safari for a couple minutes, turn down the music and say, "Has anyone thought much about surfing? Has anyone actually surfed in the ocean? What makes one wave bigger than another? How about a tsunami, what makes a tsunami wave so huge? Today you are going to answer those very questions with your own experiment."

Procedures:

- 1. Play the Surfin' Safari song as students enter the room
- 2. Ask the hook questions to gain student interest
- 3. Demonstrate the experimental set-up to the students. Be sure to show how they can carefully fold the piece of construction paper over the edge of the water tub so it just touches the water. When an object is dropped into the water and creates a wave, the height of the wave will be marked on the construction paper as a wet mark.
- 4. Divide students into teams of 2 or 3
- 5. Have one student from each team retrieve materials and a worksheet for the team
- 6. Tell students that they will be creating waves in water, and measuring the height of those waves. Be sure the students understand they can **ONLY DROP** the objects into the water no throwing, etc.
- 7. Walk around and observe students. If groups struggle, demonstrate dropping the stone into the water and ask how they could measure the resulting wave with the materials provided.

- 8. As groups finish their investigations, have them complete the first worksheet and discuss their findings. Using a "round robin", have student groups present their findings to the class. As a class, discuss the merits (validity) of these conclusions. Do the data support them?
- 9. Come to a class consensus that the height of a wave is determined by the mass of the object dropped or the height that the object was dropped from. Also point out that waves move uniformly in all directions away from the source. This is a time to use formative assessment techniques to ensure that consensus is reached.
- 10. Define the term amplitude as the height of the wave.
- 11. Pass out the second worksheet, have students infer that the amount of energy that was used to make the wave determines the amplitude of the wave.

Student Instructions - Do Not Write on This Sheet

Investigating Waves I

Surfin' Stones

Have you ever been surfing in the ocean? What makes one wave bigger than another? How about a tsunami, what makes those waves so huge? Today you are going to answer these questions with your own experiments. Surf's Up!

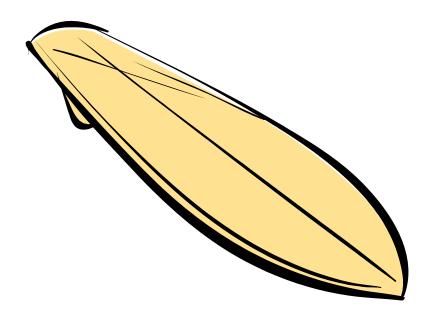
Here's What to Do:

- A- Form a group of 2 or 3 people.
- B- Get a question sheet for your group
- C- Go get a plastic tub, a couple of stones of different sizes, a meter stick, and nine strips of construction paper
- D- Fill your tub about half-way with water
- E- Design your own mini-experiment to answer the following question: What factors can I change that will affect the height of a wave?
- F- Get going with your experiment, but first, here are some things to remember: Remember to record data on your data table for each test.

Remember to conduct several trials for each test (sometimes screwy things can happen, so repeat, repeat to make sure your result isn't just one of those screwy things.)

Remember to test only one thing at a time, and keep all of the other variables constant.

Remember to label your data chart.





Student Names	Period
With your group, design your own experiment to answer this question	
Question: What factors can I change that will affect the	e height of a wave?
Using the materials you just received, describe how your group will test this out .	
What things will you change (independent variable)?	
What outcomes will you measure (dependent variables)?	
How will you measure?	
What things will you keep the same for all trials? (Constants)	
Data Table	

Data Table

Trial #		
1		
2		
3		
4		
5		
6		
7		
8		
9		

Look at your data and answer the following questions:

1. What change(s) did you make to create "tall" waves?

2. Describe the direction that a wave moves in relation to the source.

Surfin' Stones Part II

1. Think about Isaac Newton sitting under the apple tree deep in thought about gravity. a. Two apples of different masses drop from the same height and bonk him on the head. Which deliver the most energy on impact? How do you know this (give proof)?
b. Two apples of the same mass drop from different heights and bonk him on the head. Which delivers the most energy on impact? How do you know this (give proof)?
2. What can you infer about the relationship between energy and the amplitude of a wave?